INDEPENDENT RELEASE VERIFICATION AND VALIDATION PLAN (IRVVP) ECS RELEASE A

Final

(Deliverable 0608A)

January 31, 1996

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1. INTRODUCTION

1.1 Purpose

The purpose of this Independent Release Verification and Validation Plan (IRVVP) for the EOSDIS Core System (ECS) Release A is to document:

1. The organizational relationships between IV&V and the ESDIS Project and ECS developer, "Hughes Information Technology Systems" (HITS),
2. The results of an ECS Release A Criticality Analysis and Risk Assessment (CARA),
3. The Release A specific IV&V level-of-effort activities that are to be performed,
4. The programmatic aspects of the EOSDIS IV&V ECS Release A development analysis effort (schedule and resource allocation), and
5. The reporting mechanisms employed.

The IRVVP follows the guidelines established for IV&V in the EOSDIS IV&V Management Plan **[1]** and in the Independent System Verification and Validation Plan **[2].** Section 2 documents the Release A lifecycle phase independent activity results, and Section 3 documents the lifecycle dependent activities. Appendix A provides the CARA methodology and results, and appendices B and C document the programmatic aspects of the effort. Appendix D documents the reporting mechanisms.

1.2 Scope

This IRVVP addresses the focus of IV&V development analysis activities to be performed during the period 1 February 1996 to 30 September 1996 for Release A as defined in the IV&V Development Analysis Statement of Work **[3].** Specific analysis activities are as follows:

- Analyze software code and software development documentation (e.g., software development plans, project instructions, configuration management plans) for ECS Release A to assess whether the implementation is traceable to the design and of high quality (i.e., components comply with standards, are internally consistent, do not implement unintended functionality, support desired user interaction, and do not adversely impact the expandability of the system, etc.). Results will be correlated with CARA results and previous design analysis findings, and will be used to focus test witnessing, I&T, and other IV&V lifecycle analysis activities. Findings, including various complexity metrics, impacts, and recommendations will be documented in an ECS Release A Software Development Analysis TAM delivered one month prior to the final Release A TRR/ETR.

- Witness ECS Release A testing (system I&T) and assess the traceability and testability of the test results. Test witnessing activities will be coordinated with the ESDIS Project and ECS Quality Assurance (QA) representatives. Results will be documented in an ECS Release A Test Results Evaluation TAM delivered at the end of Release A system I&T, one week prior to CSR. The primary focus of the TAM is to assist the test organizations in preparing for subsequent component, science software, and SI&T testing activities.

1.3 ECS Release A Capability Overview

ECS Release A consists of capabilities which support the TRMM mission, Landsat 7 early interface testing, EOS AM-1 interface testing as well as interoperability with EOSDIS Version 0 (V0). For the TRMM mission, ECS provides additional data processing, ingest and archival services at the Langley Research Center (LaRC), Marshall Space Flight Center (MSFC) (TBR), and the Goddard Space Flight Center (GSFC) for L0 through L4 data products, and provides access to archived data. For Landsat 7 early interface testing, the ECS provides the basic ingest services for L0R data at the EDC DAAC. To support the EOS AM-1 interface testing, the ECS provides the core flight operations infrastructure to interface with the AM-1 spacecraft. To support the interoperability of V0 and V1, the ECS provides the services to allow V0 users to access V1 data, and vice versa.

2. LIFECYCLE PHASE INDEPENDENT ACTIVITIES

Lifecycle phase independent IV&V activities for ECS Release A are those whose execution is independent of the particular lifecycle phase in which they are executed. This section addresses the organizational interfaces and mechanisms, Criticality Analysis and Risk Assessment (CARA) for ECS Release A, and ad hoc document review support.

2.1 Organizational Interfaces and Mechanisms

The EOSDIS IV&V team will identify, through coordination with the ESDIS Project and the HITS IV&V point of contact (POC), technical and management points of contact within the ECS Release A development and test organizations. Exhibit 2-1 shows the breakout of potential HITS POCs for IV&V Release A development analysis and test witnessing activities.

IV&V Release A Activity	HITS POC Area	HITS POC*
ECS Release A Design and Development	SCDO Release A Development Manager	P. Ambardekar
Analysis	CSS Development	E. Winston
	MSS Development	G. Foreman
	IOS, CLS, and DMS Development	E. Winston
	PLS Development	K. Loya
	DSS Development	M. Huber
	INS Development	C. Gire
	FOS Release A Development Manager	C. Moore
	FOS Release A Subsystems	TBD
	Release A Configuration Management	TBD
	Release A Quality Assurance	TBD
ECS Release A Test Witnessing	Release A I&T (SCDO)	D. O'Neill
	Release A I&T (FOS)	H. Schroeder
	Release A Test Leads (SCDO)	TBD
	Release A Test Leads (FOS)	TBD
	Release A Configuration Management	TBD
	Release A Quality Assurance	TBD

* POCs may change at HITS discretion

EXHIBIT 2-1: HITS POCs for IV&V Release A Activities

The HITS Release A Configuration Management (CM) POC will be IV&V's primary POC for obtaining code to conduct development analysis activities. The HITS development test leads will be the contact points for resolution of technical questions, as needed.

The designated HITS Release A quality assurance representative(s) will be IV&V's primary POC for coordinating Release A test witnessing activities. The HITS Release A Test Manager will be IV&V's POC for Release A test status reporting. IV&V will interact with test leads for information on individual test execution and related technical questions, as needed.

The IV&V development analysis and test witnessing teams will utilize IV&V designated office space at the HITS facility to facilitate communication and access to information.

2.2 Critical Analysis and Risk Assessment (CARA)

One of the initial steps in planning and allocating IV&V resources to a release effort is to perform a Criticality Analysis and Risk Assessment (CARA) study. The outcome of the study allows the IV&V team to assign priorities to the various release components and assures that the most critical areas receive adequate coverage. Section 2.2 of the Independent System Verification and Validation Plan (ISVVP) **[2]** details the overall methodology for performing a CARA.

The Release A CARA was conducted on January 23-24, 1996 by three teams, one team assigned to FOS, one team assigned to SDPS, and one team assigned to CSMS. Three individuals were assigned to each team. Each participant performed an independent analysis for their assigned area (FOS, SDPS, CSMS). Lessons learned from previously performed CARAs have been incorporated into this CARA, and lessons learned from this CARA will be applied to future CARA activities. Release A subsystems were rated in four criticality areas (functionality, performance, safety, and security) and seven risk areas (programmatic constraints, requirements uncertainty, engineering complexity, technology maturity, experience base maturity, development process maturity, and testability). A description of the CARA methodology is included in Appendix A (A.1).

Based on the criticality and risk ratings assigned by each participant on a team, composite scores were calculated resulting in an overall CARA rating for each subsystem where high scores indicate areas of potentially higher criticality and risk. Summarized CARA results are shown in exhibit 2-2, indicating the subsystems that received the highest CARA criticality and risk evaluations. Additional detail is provided in Appendix A (A.2).

Segment	Subsystem
SCDO	CSMS-Communication Server Subsystem SDPS-Data Server Subsystem SDPS-Planning Subsystem
FOS	FOS-FUI FOS-TLM FOS-RMS

EXHIBIT 2-2: CARA Summarized Results for Release A

2.3 Document Review

EOSDIS software documentation reviews are conducted to observe measurable progress in the software completion process by reviewing and analyzing contractor delivered software design and development documentation. Section 2.5 of the ISVVP [2] describes the goals and approach for

performing such reviews. There are two kinds of document reviews conducted by the IV&V Team, namely:

- Document revisions received via the ESDIS CCB process as Configuration Change Requests (CCRs). IV&V responses are submitted in the form of ESDIS Project CCR Impact Analysis Reports. An example may be a CCR proposing changes to Level 3 requirements which could present a potential impact to the Release A detailed design.

- Document review requests distributed to the IV&V organization by the ESDIS Project. IV&V responses are submitted in the form of TAMs. An example includes review of a final database design specification submitted after the CDR.

The IV&V Team has reviewed several design-related documents in support of the Release A CDRs; findings have been documented in Technical Analysis Memoranda (TAMs). Subsequent review of revised Release A CDR documents will be reviewed as they are received by the IV&V organization through the ESDIS CCB channel. The Release A CARA results (Appendix A.2) will provide the focus for reviewing Release A documents.

3. LIFECYCLE PHASE DEPENDENT ACTIVITIES

Lifecycle phase dependent activities are those performed during specific phases of the ECS development lifecycle. The IV&V development analysis team will support the following major ECS Release A activities as defined in the ISVVP during the period from 1 February 1996 to 30 September 1996:

- Design Evaluation
- Software Development Evaluation
- Test Evaluation
- Formal Review Support

3.1 Design Evaluation

The majority of the Release A design evaluation was conducted during the CDR time frame. Design documentation updates will be reviewed as they are received via the ESDIS CCR and document review request process. Release A CARA results (Appendix A.2) will be applied to the review process, as necessary, to focus IV&V attention to the most critical areas.

Design evaluation consists of examining both the process in which the contractor produced the design for ECS Release A and the actual products generated by the effort. Follow-on design analysis will focus on reviewing the progress of software development processes and changes, and enhancements to design products. Exhibit 3-1 shows the anticipated focus of continuing Release A design analysis activities.

Developer Design Process
Software Development Plan
StP Utilization
Developer Design Products
Revised Subsystem Design Specs (305 Specs)
Revised Database Design Specs (311 Specs)
Updated StP Design Repository
ECS Operations Scenarios (605 Spec)

EXHIBIT 3-1: Release A Design Analysis Activities

3.2 Software Development Evaluation

Software development evaluation consists of the IV&V Team analyzing software code and related documents and databases to assess whether the implementation is traceable to the design and of high quality. The McCabe tool is key to the Release A software development analysis as it will be used to generate various metrics relating to the quality and complexity of the code and design. The software will also be checked for standards compliance, internal code consistency, appropriate functionality, and support of desired user interaction, as appropriate. The Release A CARA results (Appendix A.2) will guide the process by which the IV&V Team selects the specific software items to evaluate. The IV&V Team will employ the following process in performing Release A software development analyses:

- Identify subsystem components (i.e., CSCIs) to be examined based on the CARA results (Appendix A.2) and ESDIS Project coordination.
- Obtain code snapshots of identified software components during the code walk through period through ECS Release A Configuration Manager.
- Process code through McCabe tool. Output is McCabe metrics reports.
- Analyze metrics based on lifecycle stage.
- Analyze conformance to standards, internal code consistency, etc. (as time permits).
- Document findings in Release A Software Development Evaluation TAM, due one month prior to the final Release A TRR/ETR.

ECS Release A Software Development Evaluation is primarily product oriented (i.e., focus is examination of software code); however, the implementation of software development processes (e.g., adherence to development standards) will be examined also. Exhibit 3-2 shows the ECS process and product related documentation that applies to the IV&V software development evaluation.

Software Development Process Related Documents
Configuration Management Plan 102/MG1
Configuration Management Procedures 103/MG3
Data Management Plan 104/MG1
Data Management Procedures 105/MG3
Software Development Plan 308/DV2
Development Plans 329/DV2
Software Development Product Related Documents/Databases
Software Code Snapshots
Software Development Folders
StP Design Repository
RTM Repository

EXHIBIT 3-2: ECS Process and Product Related Documents Supporting IV&V Software Development Evaluation

3.3 Test Evaluation

Test evaluation consists of the IV&V team witnessing and independently analyzing results of system I&T tests performed by the ECS contractor. The Release A CARA (Appendix A.2) will guide the process by which the IV&V Team selects the specific tests to evaluate. The IV&V Team will employ the following process in performing Release A test evaluation:

- Obtain system I&T test and verification plans, and test schedules.
- Review plans for sufficiency and completeness of test coverage and requirements traceability.
- Identify tests to witness based on Release A CARA results (Appendix A.2), requirements criticality,

and through ESDIS Project coordination.

- Witness tests.
- Independently analyze test results provided by the ECS developer to assess test conduct compliance to plans and procedures, and to verify that the results accurately and completely reflect the outcome of the tests.
- Attend HITs Release A I&T status meetings.
- Provide interim progress/status memoranda to ESDIS project (format and content to be determined in coordination with ESDIS Project).
- Document findings in Release A Test Results Evaluation TAM, due one week prior to the Release A CSR.

ECS Release A Test Process Evaluation focuses on how the HITS test process is implemented. The evaluation examines the test plans for the system as well as the verification plan, and the system integration and test plans to assess the likelihood that the process will (continue to) yield the required implementation end-products. Exhibit 3-3 lists the possible processes and products to be applied to IV&V test evaluation activities.

Test Evaluation Process Related Documents
ECS Implementation Plan 301/DV1
ECS System Integration and Test Plan 402/VE1
ECS Overall System Acceptance Plan 409/VE1
Integration and Test Plan 319/DV1
Integration and Test Plan 319/DV1
Monthly Tabulation of S/W Errors 326/DV3
Maintenance and Operations Procedures 609/OP1
Integration and Test Report. 324/DV3
Maintenance and Ops Procedures 607/OP2
Training Material 625/OP3
ECS Operations Plan 608/OP1
Test Evaluation Product Related Documents
ECS Test Status Reports
ECS Discrepancy Reports

EXHIBIT 3-3: ECS Process and Product Related Documents Supporting IV&V Test Evaluation

3.4 Formal Review Support

Formal review support, as defined in Section 2.6 of the ISVVP[2], involves participation of the IV&V Team in major program milestones. The IV&V Team evaluates the products associated with each review along with related studies, and in turn provides independent evaluations of the program at a specific milestones. Specific goals associated with each milestone are documented in Section 2.6 of the ISVVP [2].

The following major reviews associated with ECS Release A will be supported by the IV&V Team:

Test Readiness Review/Element Test Review (TRR/ETR)	20 May 1996 (Final Review in Series)
Consent to Ship Review (CSR)	1 October 1996
Release Readiness Review (RRR)	1 December 1996

The IV&V Team will attend these reviews and identify technical issues as required. Evaluations of supporting documentation and potential issues will be reported through the Technical Analysis Memoranda (TAM) vehicle and the Technical Issues Memorandum (TIM) vehicle described in Appendix D.

Appendix A: CARA METHODOLOGY AND RESULTS

CARA methodology is described in Section A.1. CARA results for ECS Release A are described in section A.2.

A.1 CARA METHODOLOGY

Assumptions:
Specific documentation was recommended for each subsystem within SDPS, CSMS, and FOS. The CDR specification and presentation materials were used as references to produce the CARA for Release A. Certain underlying assumptions were applied by CARA participants when evaluating each of their assigned subsystems according to the given criticality and risk factors. Criticality, for example, was assumed to mean how critical each subsystem was (based on its components) to the Release A mission. Risk was assumed to mean the degree of risk the CARA reviewer felt was associated with a particular subsystem to progress from the present state to a completed state, thus satisfying Release A requirements.

CARA Scoring:
Release A subsystems were evaluated in four criticality and seven risk areas and assigned ratings shown in Exhibit A-1.

CRITICALITY RATING	DESCRIPTION
3	Critical
2	Essential
1	Fulfillment

RISK RATING	DESCRIPTION
3	High
2	Medium
1	Low

EXHIBIT A-1: CARA Criticality and Risk Rating

Criticality Assessment:
Each participant rated each of their assigned subsystems in 4 areas of criticality. The criticality categories and sample criteria for each category are shown in Exhibit A-2. A whole number from 1-3 was assigned to each category and the number entered into the criticality/risk spreadsheet.

	Criticality Evaluation Categories and Criteria		
Criticality Area	**Critical (3)**	**Essential (2)**	**Fulfillment (1)**
Functionality	• Failure could result in complete and permanent loss of system functionality • Subsystem fails to implement required functionality	• Failure could result in partial loss of system functionality significantly limiting mission objectives	• Failure could result in minor loss of system functionality minimally limiting mission objectives
Performance	• Failure could result in severe performance degradation resulting in halted or aborted processes	• Failure could result in significant degradation of system performance	• Failure could result in time delay in providing service or product
Safety	• Failure could result in loss of space assets	• Failure could result in loss of emergency safeguards • Failure could result in longer term environmental damage	• Failure could result in short term transitory environmental impacts
Security	• Failure could result in loss, corruption, or alteration of data or processes (non-recoverable) • Failure could result in serious security breakdown risking compromise of system capabilities or data (non-recoverable)	• Failure could result in loss, corruption, or alteration of data or processes (recoverable, but with limitations and/or moderate delay) • Failure could result in less severe security breakdown allowing access to capabilities or data (recoverable, but with limitations and/or moderate delay)	• Failure could result in minor loss, corruption, or alteration of data (fully recoverable with minimal delay)

EXHIBIT A-2: Criticality Criteria

Functionality - refers to the ability of the subsystem to meet functional requirements in support of defined missions for the Release.

Performance - refers to the ability of the subsystem to deliver required system performance in support of user demand profiles and defined missions for the Release.

Safety - refers to the ability of the subsystem to operate without damage to or loss of fixed or space assets.

Security - refers to the ability of the subsystem to maintain data security and data integrity, and prevent unauthorized use or inadvertent misuse.

Risk Assessment:
Each participant rated their assigned subsystems according to 7 risk drivers . The risk drivers are defined in Exhibit A-3. A whole number from 1-3 was assigned to each category and the number entered into the criticality/risk spreadsheet. Note: for risk ratings only, fractional numbers 1.5 and 2.5 were accepted.

	Risk Drivers and Criteria		
Risk Driver	**High (3)**	**Medium (2)**	**Low (1)**
Programmatic Constraints	• Could threaten continued survival of project • Could cause public criticism of project administration • Could seriously compromise system capabilities	• Could necessitate redesign efforts • Could seriously compromise system capabilities	• Could cause deviations from established plans • Could necessitate minor additional costs
Requirements Uncertainty	• Lack of an established requirements baseline • Requirements definition draws on multiple, diverse sources • Requirements represent compromise of divergent viewpoints	• Some tuning of requirements possible, but few wholesale changes • Requirements definition process has clear lines of responsibility • Unanimity concerning performance expectations	• Stable requirements baseline with clear, precise expression • Source for requirements identified • Clear consensus on expected system performance
Engineering Complexity	• Highly complicated control logic • Unique devices • Many and varied interfaces with much data passage • Many control states and operational modes • Highly distributed functionality • Strict real-time operations	• Some control flow branching • Some device dependencies • Multiple, structured interfaces • Some mode/state dependencies • Minimal distribution of functionality • No hard time dependencies	• Purely sequential control flow • No device dependencies • Minimal data sharing over interfaces • Operates in only a few modes or states • Operates in a single device • Operates independent of time
Technology Maturity	• New, unproved algorithms, languages, environments • Direct application of current research	• Design base and tool sets have been used before • At cutting edge, but some lessons learned available • Limited prototyping,	• Design basis and tool sets proven by use on similar applications • Lessons learned are common knowledge • In common use throughout the

	Risk Drivers and Criteria		
Risk Driver	**High (3)**	**Medium (2)**	**Low (1)**
		but includes most key technologies	industry
Experience Base Maturity	• No previous experience with application instance • Unfamiliar with NASA management • Lacks experience with selected development regime and tools	• Has delivered similar systems in past • Knows NASA way of doing business • Managers have first hand experience with tools and development regime	• Recognized industry leader for this application • Long-time NASA customer • All elements of work force familiar with development regime and tools
Dev Process Maturity	• Selected approach never used before • Creating methodology as the development progresses • Trial and error process of discovering what works and what doesn't • Complex, multistage build process with overlapping integration tracks	• Approach has been used with some success in past on similar projects • Methodology and process are documented • Guidelines for use are available • Multiple build tracks with well-paced integration schedules	• Well-defined and well-documented approach • Managers thoroughly familiar with methodology • Methodology proven on many similar programs • Single build and integration
Testability	• Difficult to test • Requires complicated drivers, simulators and analytic tools • Many input and operational environment variations • Complex environment	• Some difficulty in testing but methods are known • Drivers, simulators, tools are standard off-the-shelf • Limited variability in inputs • Test environment well understood	• Standard, pre-defined test cases/ canned scenarios • Simple, easy test inputs • Little or no results analysis required • Non-complex test environment

EXHIBIT A-3: Risk Criteria

Programmatic - Refers to the ability of the subsystem to meet the developmental budgetary and schedule constraints.

Requirements Uncertainty - Refers to the degree of stability in the overall set of requirements and the firmness of their expression.

Engineering Complexity - Refers to the degree of coupling, interdependency or inherent difficulty associated with the design, implementation, test and operation of the subsystem.

Technology Base Maturity - Refers to how long the technology base, including the development environment, algorithms, software languages, etc. has been in common use throughout the industry.

Experience Base Maturity - Refers to the availability of trained resources within the development organization.

Development Process Maturity - Refers to the capabilities and suitability of the selected development regime to support development, integration, and test of the application.

Testability - Refers to the degree of difficulty associated with testing the system element and its underlying requirements.

Confidence Ratings:
CARA participants assigned confidence ratings to each criticality and risk assessment area for each subsystem as follows:

Confidence:

1 The rating is an educated guess.
2 Somewhat confident that the rating is correct.
3 Strong confidence that the rating is correct
4 Unlikely that anyone would disagree with this rating.

Each CARA was conducted with the following instructions given to the participants:

1. Rate each subsystem according to the 4 criticality and 7 risk criteria.

   Criticality Ratings: 1 (low) to 3 (high) **No fractions**
   Risk Ratings: 1 (low) to 3 (high) **may use fractions 1.5 and 2.5, if necessary**

2. Rate your level of confidence for each criticality and risk rating you assigned.

   1 (low confidence) to 4 (high confidence)

3. Specify rationale for your rating.

4. Enter criticality/confidence ratings, risk/confidence ratings and rationale into your designated spreadsheet on r: drive. NO BLANKS.

5. Log your time spent. At the bottom of each worksheet (1 worksheet per subsystem) there is a place to enter the time you spent doing the assessment for that particular subsystem.

Once ratings were assigned to the different criticality and risk categories, composite scores were calculated leading ultimately to an overall CARA rating, where high scores indicate areas of concern. Evaluations were performed at the subsystem level. A summary of CARA results is provided in Appendix A.2.

A.2 CARA Results

- **The SCDO subsystems that rated the highest CARA were CSMS-CSS with 6.5, SDPS-DSS with 6.2 and SDPS-PLS with 5.5 all on a scale from 1-9**. The SCDO Release A supports the services required to provide hardware, software and operations to ingest, plan, process, archive, manage, and access data and related information from the entire EOSDIS. It also is used to interconnect users and service providers, transfer information between the ECS and many EOSDIS components, and mange all ECS components.

  CSS received the highest rating in part because of its technical maturity risks. This subsystem uses Open Software Foundation/Distributed Computing Environment (OSF/DCE), Version 1.03 which is not a mature technology. The fact that OSF/DCE is not fully supported across heterogeneous platforms has presented many challenges during IR1 testing to work around. This subsystem is needed to provide wide area and local area network connections within a distributed environment (software components execute on two or more processors) in order to provide data to the various end users.

  SDPS-DSS was rated high due to the risk associated with integrating DSS with CSMS. SDPS-PLS is dependent on the successful integration of Hughes Class Library and is a highly critical system for handling user requests.

- **The FOS subsystems that rated highest in the CARA were the FUI with 6.4, the TLM and RMS with a rating of 5.9 each all on a scale of 1-9.** The focus of Release A Flight Operations is early AM-1 testing rather than actual spacecraft operations. Operations staff need to fully understand the FUI to ensure system capabilities from an operations perspective. Therefore, the User Interface (FOS-FUI) was assessed as the most critical area. The Release A FOS will be a test bed for the Release B FOS. The FOS-TLM and FOS-RMS subsystems will be critical to Release B FOS and were assigned a high CARA partly due to this. The TLM subsystem operates in many control states, and receiving telemetry data is critical to the success of the mission. The RMS subsystem is used to facilitate remote operational failure recovery during real-time contacts and is critical to the success of the mission. The FOS-DMS and FOS-PAS are considered nearly as critical as FOS-TLM and FOS-RMS, as shown by their CARA ratings of 5.7.

The results of the CARA for CSMS, SDPS and FOS are summarized in Exhibits A-4, A-5, and A-6 followed by an explanation of the formulas used for computing the totals.

Criticality Area	Weight	CSMS Overall	Criticality Totals CSS	MSS	ISS
Functionality	0.300	2.4	2.7	2.3	2.3
Performance	0.350	2.5	2.8	2.3	2.4
Safety	0.150	1.6	1.8	1.2	1.7
Security	0.200	1.9	2.0	1.8	2.0
Composite Criticality	1.000	2.2	2.5	2.0	2.2
Risk Driver	Weight	CSMS Overall	Risk Totals CSS	MSS	ISS
Programmatic Constraints	0.150	2.6	3.0	2.8	2.0
Rqmts. Uncertainty	0.110	2.0	2.2	2.2	1.7
Engineering Complexity	0.160	2.7	3.0	3.0	2.0
Technology Maturity	0.160	2.2	2.3	2.5	1.8
Experience. Base Maturity	0.110	2.4	2.5	3.0	1.8
Dev. Process Maturity	0.150	2.2	2.5	2.0	2.0
Testability	0.160	2.2	2.4	2.2	2.0
Composite Risk	1.000	2.3	2.6	2.5	1.9
CSMS		CSMS	CSS	MSS	ISS
CARA Rating		5.1	6.5	5.0	4.2

EXHIBIT A-4: Overall CARA Results for CSMS Release A

Criticality Area	Weight	SDPS Overall	Criticality Totals CLS	IOS	DMS	DSS	INS	DPS	PLS
Functionality	0.300	2.6	2.1	2.1	2.3	3.0	3.0	2.7	2.7
Performance	0.350	2.5	1.8	2.0	2.3	3.0	2.7	3.0	2.7
Safety	0.150	1.1	1.0	1.0	1.3	1.3	1.0	1.3	1.0
Security	0.200	1.8	1.4	1.3	2.0	2.5	2.3	1.4	1.7
Composite Criticality	1.000	2.2	1.7	1.7	2.1	2.6	2.5	2.3	2.2
Risk Driver	Weight	SDPS Overall	Risk Totals CLS	IOS	DMS	DSS	INS	DPS	PLS
Programmatic Constraints	0.150	2.3	1.3	1.6	1.6	2.7	3.0	2.7	3.0
Rqmts. Uncertainty	0.110	1.7	1.3	1.5	1.9	2.0	1.5	2.0	1.6
Engineering Complexity	0.160	2.2	2.0	1.3	2.0	2.7	2.4	2.0	2.7
Technology Maturity	0.160	1.9	1.4	1.7	2.0	2.1	1.6	2.0	2.4
Experience. Base Maturity	0.110	2.0	1.8	2.0	2.0	1.9	1.5	2.7	2.0
Dev. Process Maturity	0.150	2.2	1.6	2.0	2.0	2.3	2.1	2.7	2.8
Testability	0.160	2.1	2.0	1.7	2.0	2.7	2	2.0	2.3
Composite Risk	1.000	2.1	1.6	1.7	1.9	2.4	2.1	2.3	2.5
CSMS		SDPS	CLS	IOS	DMS	DSS	INS	DPS	PLS
CARA Rating		4.6	2.7	2.9	4.0	6.2	5.3	5.3	5.5

EXHIBIT A-5: Overall CARA Results for SDPS Release A

Criticality Area	Weight	FOS Totals Overall	Criticality Totals ANA	CMD	CMS	DMS	PAS	RTC	RMS	TLM	FUI
Functionality	0.300	2.5	2.0	2.6	2.4	2.7	2.7	2.3	2.4	2.3	2.8
Performance	0.350	2.5	1.7	3.0	2.0	2.3	2.3	2.7	2.7	3.0	3.0
Safety	0.150	2.5	2.0	3.0	2.6	2.4	2.4	2.3	3.0	2.7	2.3
Security	0.200	2.7	2.0	3.0	2.8	3.0	3.0	2.3	2.7	2.6	2.7
Composite Criticality	1.000	2.6	2.0	2.9	2.4	2.6	2.6	2.4	2.7	2.7	2.8
Risk Driver	Weight	FOS Totals Overall	Risk Totals ANA	CMD	CMS	DMS	PAS	RTC	RMS	TLM	FUI
Programmatic Constr	0.150	2.2	2.2	2.3	2.3	2.3	2.3	2.0	2.0	2.2	2.0
Rqmts. Uncertainty	0.110	1.5	1.5	1.3	1.4	1.5	1.5	1.5	1.5	1.5	1.5
Engineering Complexity	0.160	2.2	1.9	2.4	2.0	2.2	2.2	2.5	2.2	1.8	2.8
Technology Maturity	0.160	2.7	2.7	2.7	2.7	2.7	2.7	2.7	2.6	2.7	2.7
Exper. Base Maturity	0.110	1.9	2.5	2.0	1.8	1.4	1.4	2.5	2.0	1.5	1.8
Dev. Process Maturity	0.150	2.5	2.7	2.2	2.6	2.6	2.6	2.5	2.4	2.6	2.6
Testability	0.160	2.2	2.4	2.4	2.2	2.0	2	2.2	2.3	2.4	2.0
Composite Risk	1.000	2.1	1.6	1.7	1.9	2.2	2.2	2.3	2.2	2.2	2.3
CSMS		FOS	ANA	CMD	CMS	DMS	PAS	RTC	RMS	TLM	FUI
CARA Rating		5.5	3.2	4.9	4.6	5.7	5.7	5.5	5.9	5.9	6.4

EXHIBIT A-6: Overall CARA Results for FOS Release A

Definitions:

Criticality Totals (by Subsytem) Columns

Three reviewers analyzed each ECS area (i.e. SDPS, CSMS and FOS). The numbers in each subsystem column were computed using a weighted confidence multiplier. This discriminated between the levels of confidence each reviewer had in their assessment of the subsytem. The computation multiplied each reviewer's criticality or risk rating times that reviewer's confidence level, and divided by the sum of the three confidence levels.

An example of computing risk for a subsystem (see Appendix A.1 for description of confidence rating) is as follows:

Apply formula: ((R1*C1)+(R2*C2)+(R3*C3))/(C1+C2+C3) where
R1=Risk rating from analyst 1 C1=Confidence from analyst1
R2=Risk rating from analyst 2 C2=Confidence from analyst2

R3=Risk rating from analyst 3 C3=Confidence from analyst3

Overall Column
The overall criticality and risk values were computed by taking the mean of the three reviewer's total criticality or risk ratings.

Example of computing CSMS Overall functionality:
Apply formula: (S1+S2+S3)/3
S1=Risk rating for CSS subsystem
S2=Risk rating for MSS subsystem
S3=Risk rating for ISS subsystem

Composite Criticality and Composite Risk Row:
The final Composite Criticality and Composite Risk numbers were computed using the weights assigned in the Weight column. These weights were chosen to represent the relative importance of each criticality area and risk driver as compared to each other.

Example of computing Composite Criticality:
Apply formula: (CT1*W1)+(CT2*W2)+(CT3*W3)+(CT4*W4)

CT1=Functionality total for susbsystem	W1=Weight for functionality
CT2=Performance total for susbsystem	W2=Weight for Performance
CT3=Safety total for susbsystem	W3=Weight for Safety
CT4=Security total for susbsystem	W4=Weight for Security

CARA Rating Row:
The Composite Criticality multiplied by the Composite Risk is the final CARA Rating (based on a scale of 1-9)

Apply Formula: (Risk * Criticality) = CARA Rating

Appendix B: Task Activity Schedule

Task 6 IV&V activities will center on major ECS program milestones. The milestones that have been identified for ECS Release A are as follows:

Final Test Readiness Review Review(TRR/ETR)	20 May (Final Review in Element Test Review Element Test Series)
Consent to Ship Review (CSR)	1 October 1996
Release Readiness Review (RRR)	1 December 1996

The Release A development analysis deliverables to be completed during the period of performance from 1 February 1996 through 30 September 1996 are as follows:

Deliverable	Deliverable ID	Date Required
Software Development Analysis TAM	0611	Final Release A TRR/ETR - 1 Month
Test Results Evaluation TAM	0615	Release A CSR - 1 Week
IV&V Metrics Report	0616	Monthly (end of each month)

EXHIBIT B-1: Release A Deliverables

Exhibit B-2 shows a schedule summarizing the activities and deliverables associated with the development analysis of ECS Release A. Major deliverables and approximate duration of associated subtasks are shown.

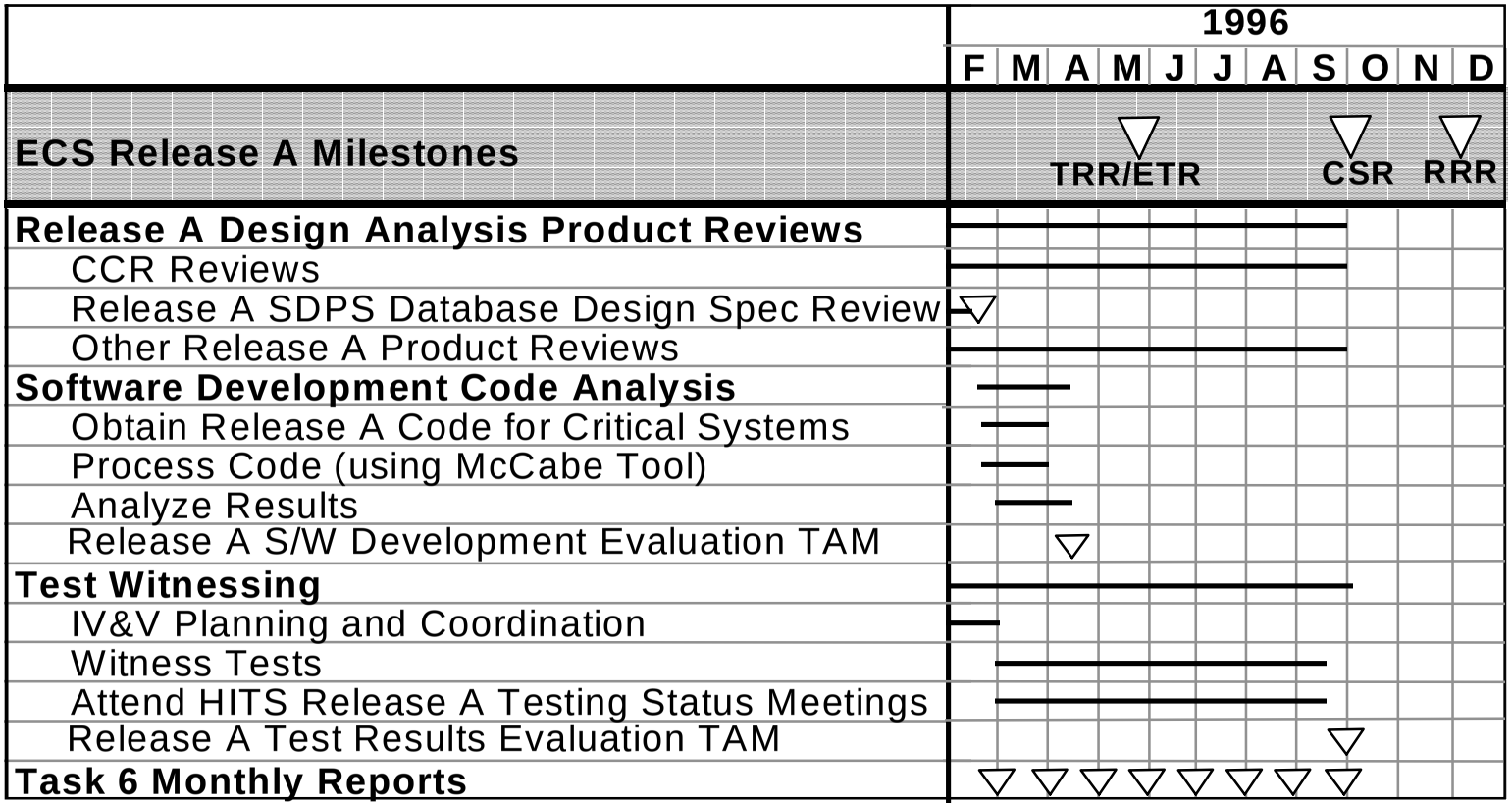

EXHIBIT B-2: EOSDIS IV&V Task 6 ECS Release A Development Analysis Schedule

Appendix C: Task Resource Allocation

The following labor categories have been allocated to support development analysis activities of the ECS Release A:

- Senior Systems Engineer
- Systems Engineer
- Database Specialist

Exhibit C-1 details the planned allocation of resources per month, and by labor category, for Task 6, along with the total amount allocated to Release A activities.

	1996							
	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep
Sr. Systems Engineer	3.25	1.5	.75	1.75	1.75	1.75	1.75	1.75
Systems Engineer	.75	.5	.5	.5	.5	.5	.5	.5
Database Specialist	1	.75	.5	.5	.5	.5	.5	.5
Total Allocation to Release A Activities	5	2.75	1.75	2.75	2.75	2.75	2.75	2.75

EXHIBIT C-1: Planned Release A Resource Allocation for Task 6

Appendix D: Report Formats

This appendix describes the report formats used to document analysis findings supporting IV&V ECS Release A Development Analysis activities. Specific reporting mechanisms are as follows:

- EOSDIS IV&V Technical Analysis Memorandum (TAM)
- EOSDIS IV&V Technical Issues Memorandum (TIM)
- ESDIS Project CCR Impact Analysis Report
- Monthly Metrics Report

The EOSDIS IV&V TAM format is used to document IV&V Release A software development and test evaluation deliverables as well as the results of document reviews. The TAM format is illustrated in Section D.1. TIMs are used track and report information on issues to facilitate early Project visibility into important issues. The format for the TIM is currently being developed; however, a general description of the TIM as well as the types of information to be tracked is described in Section D.2. CCR Impact Analysis Reports are used to provide comments, recommendations, and potential impacts in response to proposed changes to EOSDIS documents. The IV&V Team uses the report format provided by the ESDIS Configuration Control Board (CCB) which is shown in Section D.3. The IV&V Team will submit monthly metrics reports associated with Release A development analysis activities. The content and format of this report is to be determined in coordination with the ESDIS Project.

D.1 EOSDIS IV&V Technical Analysis Memorandum (TAM) Format

To: {cognizant person - usually the applicable NASA manager}

From: EOSDIS IV&V Team

Subject: {the topic of this TAM}

1. ***Context*** - {describe the specific configuration(s)/area(s)/document(s)/etc. affected}

2. ***Discussion*** - {discuss specific concerns(s)/reason(s) - what/why - for writing this}

3. ***Recommendations*** - {what do you suggest needs to be done - who/what/why}

4. ***Recommended Distribution*** - {who else should receive this - organization/name}

Originator:

_____
{typed name}
EOSDIS IV&V Analyst

Approved:

_____
{typed name}
EOSDIS IV&V Task Lead

D.2 EOSDIS Technical Issues Memorandum (TIM) Description

The Project Issue Tracking System (PITS) is being developed to provide an automated mechanism to document and track issues in a way that enhances overall IV&V effectiveness. The PITS supports a rigorous, repeatable process which facilitates the identification and resolution, over time, of important issues and the analysis of trends. It is targeted at the complete system development life cycle and the effective monitoring of all categories and domains of issues that significantly affect ongoing project success. This distinguishes it from other issue tracking systems which primarily focus on project milestone issues (like Review Item Discrepancy (RID) tracking systems), development product related issues (like the Distributed Defect Tracking System (DDTS)), etc..

Issues have a life cycle of their own: identification (existence), documentation (description/ prescription), publication (opened), remedial actions (resolution), and termination (closure). Unlike Technical Analysis Memoranda (TAMs), the PITS covers the complete issue life cycle. TAMs stop after the issue publication phase; there is no formal mechanism to follow-up on the successful resolution of issues. Consequently, on the surface, an "old" TAM looks like an "old" analysis and set of issues. An "old" issue is only really "old" when it is no longer an issue (i.e., the issue has been satisfactorily resolved or overtaken by events). The PITS is the primary mechanism for documenting the extent to which issues generated at a given moment-in-time are still important at a later moment-in-time.

The TAM documents a fairly broad set of issues at varying levels of importance (severity and criticality) that result from comprehensive analyses. TAMs, in particular, are both a timely and a thorough mechanism for understanding why and what issues exist, but the overall importance of a TAM is diluted by the varying importance of the issues it raises. Issues at all levels of importance should be documented (as they are, and will continue to be, in TAMs). However, those of marginal-value (i.e., do not significantly affect success) need not be given a high-level of management attention. The PITS filters-out issues of marginal-value, so that project management can concentrate on the resolution of the issues that truly matter.

The vehicle for documenting and tracking issues within a PITS repository is the Technical Issue Memorandum (TIM). A TIM is a named, discrete collection of metadata (searchable issue characterization and status information), descriptive text, prescriptive text, and resolution progress information. Each TIM is focused on a clearly defined set of issues at the same level of importance. Each TIM supports the tracking of issue resolution progress to closure (via the PITS "Resolution Chronology").

The TIM report format is still under development; however the information to be tracked for a particular issue is shown in Exhibit D-1.

Data Item	Description
Issue Category	the category of the issue, keyed to the system development life cycle (e.g., "Requirements", "Integration & Test") and project management (e.g., "Engineering Processes", "Programmatics")
Impact Category	the category of the impact of the issue, keyed to the system development life cycle (e.g., "Requirements", "Integration & Test") and project management (e.g., "Engineering Processes", "Programmatics")
Issue Domain 1	the project development activity and phase that the issue is associated with (e.g., "ECS Rel A", "EGS Version 2")
Issue Domain 2 (optional)	same as Domain 1
Issue Milestone (optional, associated with Domain 1)	the formal review that the issue pertains to (e.g., "CDR", "CSR")
Issue Severity	the severity level of the issue (e.g., "Major", "Moderate", "Minor")
Issue Criticality	the level of criticality of the issue (e.g., "Critical", "Essential", "Fulfillment"
Issue Visibility	defines who has access to the issue (e.g., "Public", "Private")
Issue Status	disposition of issue (e.g., "Draft", "Opened", "Closed", "Closed with Concerns"
Issue Dates	dates issue was opened, closed, and updated
Issue Subject	brief summary of issue
Issue Description	Concise and complete description of issue
Impact Description	Concise and complete description of impacts of issue
Recommendations	List of recommendations or actions needed to fix the issue
Closure Criteria	Minimum criteria which must be satisfied to close issue
Relationships	TAMs, RIDs, etc. that address or are associated with this issue

EXHIBIT D-1: TIM Data Items

D.3 EOSDIS CCR Impact Analysis Report Format

CCR#	**CCR Title**	**CCR Sponsor**
Date Dist.	**Comments Due:**	**Due Date**
Comments		
Recommendations		
Potential Impacts		**None**
Cost:		
Schedule:		
Requested by SMO	**Signature & Date**	

Appendix E: List of References

IV&V Documents

[1] Deliverable 0301 EOSDIS Independent Verification and Validation (IV&V) Management Plan, December 2, 1994

[2] Deliverable 0302 Independent System Verification and Validation Plan (ISVVP), December 15, 1994

[3] EOSDIS IV&V Task 6B, ECS Development Analysis, Statement of Work, January 25, 1996.

[4] Preliminary ECS Release A IRVVP, Deliverable 0601/Release A, March 31, 1995.

[5] ECS Project organization 7/95

Appendix F: Tools and Data Bases Utilized

Task 6 activities will utilize a number of tools during the analysis and evaluations of Release A products and processes. Exhibit F-1 provides a brief subset of the tools described in the Independent System Verification and Validation Plan (ISVVP) **[2]** which will support Task 6.

Tool	Utilization
RTM	Analyze requirements and traceability to tests and design using exports from ECS contractor.
ClearCase	Evaluate software development (builds/releases) and configuration management activities.
Automated Requirements Database (ARDB)	Maintain requirement evaluations, tailored also to support CARA effort.
Issue/Discrepancy Handling System (IDHS)	Store and maintain Release A issues and discrepancies.
Mosaic/Netscape	Access EDHS and download necessary files.
PITS (Project Issues Tracking System)	Issue tracking and reporting tool
DDTS (Distributed Defect Tracking System)	Issue tracking system
StP (Software through Pictures)	Object Model analysis tool
McCabe Tools	Generate software complexity and design metrics

EXHIBIT F-1: Tools to be Utilized During Release A Development Analysis

Additional tools will be identified and used as required. Any tools used during Task 6 activities will be documented in the corresponding TAM or TIM.

Appendix G: List of Acronyms

CARA	Criticality Analysis And Risk Assessment
CCB	Change Control Board
CCR	Configuration Change Request
CDR	Critical Design Review
CSMS	Communication and System Management Segment
CSR	Consent To Ship Review
ECS	EOSDIS Core System
EDHS	ECS Data Handling System
EOS	Earth Observing System
FOS	Facilities Operations Segment
GSFC	Goddard Space Flight Center
HITS	Hughes Information Technology Systems
I&T	Integration and Test
IDHS	Issue Discrepancy Handling System
IRVVP	Independent Release Verification and Validation Plan
ISVVP	Independent System Verification and Validation Plan
IV&V	Independent Verification And Validation
L0	Level 0
L4	Level 4
LaRC	Langley Research Center
MSFC	Marshall Space Flight Center
POC	Point of Contact
PDR	Preliminary Design Review
RRR	Release Readiness Review
SCDO	Science & Communications Development Office
SDPS	Science and Data Processing Segment
SI&T	System Integration and Test
TAM	Technical Analysis Memorandum
TBD	To Be Determined
TBR	To Be Reviewed
TIM	Technical Issue Memorandum
TRMM	Tropical Rainfall Measurement Mission
TRR/ETR	Test Readiness Review/Element Test Review
V0	Version 0 (Zero)
V1	Version 1